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grade 7 mathematics

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MINISTER'S MESSAGE

Technological aids are playing an increasing role in education. Among them is educational television. Its place in the school is without question, and its acceptance world-wide.

Educational television is a means not only of communicating new knowledge, but also of introducing new methods and techniques, and the importance of its role is witnessed in the fact that the developing countries of the world are introducing this medium into their educational plans as early as possible.

The present series of programs in Grade 13 Physics and Grade 7 Mathematics will launch the Department's educational television broadcasts, and I trust that teachers will use them to the best advantage with their pupils. It must be remembered that a successful ETV program is not the result of a single effort, but a partnership between the studio and the class receiving the broadcast. If one fails the other, the program cannot be effective and successful.

Plato once said, 'The instrument is useful only to the man who knows how to use it and has had enough practice in the use of it'. Educational television is such an instrument.

William G. Davis

MINISTER OF EDUCATION
November 24, 1965.

Grade 7 Mathematics

Mr. Ron Ripley, the 'on-camera' teacher and script-writer of the Mathematics Series, is a science and mathematics teacher at the University of Toronto Schools.

Mr. Ripley was born in Hamilton, Ontario. From Delta Collegiate, Hamilton, he entered McMaster University where he graduated with a B.A. degree. He later gained his M.ED. degree at the University of Toronto.

Before he joined the staff of U.T.S., Mr. Ripley taught in Forest Hill Village, Toronto. His services as a teacher and a lecturer in the new approach to Mathematics are in great demand for summer and in-service courses for teachers. He has talked to teachers and has acted as leader of workshops in Mathematics across the length and breadth of our Province.

Mr. Ripley is married and has three children. He plans to take leave of absence from teaching during the next year in order to study for his doctorate.

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Grade 7 Mathematics

PREFACE

This Teachers' Guide has been prepared in relation to the series of educational television programs on the subject, "Grade Seven Mathematics."

The topics for the broadcasts, with the exception of the first program, have been selected from the present Grade 7 Mathematics course. The first program is of a general introductory nature.

The broadcasts have been prepared by the Department of Education but have been produced in cooperation with the Canadian Broadcasting Corporation. The programs are scheduled on Monday mornings at 10.00 a.m., local time, on the CBC network.

The material in this Guide will help to introduce the broadcasts, and provides an outline of each program with some suggested follow-up classroom activities.

The broadcast scripts and the Guide outlines have been prepared by Mr. Ron Ripley, B.A., M.ED., of the staff of University of Toronto Schools. Mr. Ripley is also the 'on-camera' teacher-presenter of the series. Mr. G. A. Kaye, B.A., Assistant Superintendent, Curriculum Division, Department of Education has acted as subject supervisor during the preparation of the series.

The programs will include the following topics which will be broadcast in the order listed:

1 What is Mathematics?
2 Numbers and Numerals
3 Understanding Sets
4 Whole Numbers
5 Looking at Factors, Multiples and Primes
6 Introducing Exponential Notation
7 Number bases
8 Using Number Expressions
9 Number Sentences
10 Common Fractions
11 More about Common Fractions
12 Introducing Decimal Fractions
13 More about Decimal Fractions
14 Rates and Ratios
15 By the Hundred
16 Sets of Points
17 A Look at Areas and Volumes
18 Mathematics with a Difference (Lines into Curves)

NOTE: This folder contains the outlines for the first few broadcasts only. The others will be issued as they are prepared. Please place them into this folder as you receive them.

Grade 7 Mathematics

PROGRAM OUTLINES

Program 1
WHAT IS MATHEMATICS?
This introductory program outlines various aspects of Mathematics and presents capsule biographies of some of the great mathematicians and their contributions. Among the mathematicians discussed are Eratosthenes, Sir Isaac Newton, and Karl Friedrich Gauss.

Program 2
NUMBERS AND NUMERALS
An historical account of the development of our number system is outlined in this broadcast. Other number systems such as the Egyptian, Babylonian, Greek, Roman and Mayan are also presented.

Program 3
UNDERSTANDING SETS
This program explains the meaning of a set together with the notation of a subset, membership in a set, finite and infinite sets, equivalent sets and the empty set. The writing and graphing of set is also presented.

Program 4
WHOLE NUMBERS
The properties of whole numbers are demonstrated with blocks, a simple slide rule and a balance. Discovery methods are tried and discussed. The order of operations is demonstrated.

Program 5
LOOKING AT FACTORS, MULTIPLES AND PRIMES
The Fundamental Theorem of Arithmetic is stated and explained in this broadcast. The practical application of factors, primes and multiples is demonstrated.

Program 6
INTRODUCING EXPONENTIAL NOTATION
In this program, base, exponent, and power are explained. The value of exponential notation is illustrated by having the pupil viewers write out very large and very small numbers by using scientific (standard) notation.

Program 7
NUMBER BASES
A brief discussion of the use of bases other than 10 is included in this program. Various methods are used to aid in the understanding of number bases, and several games and puzzles are shown for interest and motivation.

Programs 8 & 9
USING NUMBER EXPRESSIONS
NUMBER SENTENCES
These two programs are devoted to the place and use of number expressions, number sentences, equalities, and inequalities. The graphing of solution sets and problem solving are discussed.

Programs 10 & 11
COMMON FRACTIONS
MORE ABOUT COMMON FRACTIONS
In these two broadcasts a visual presentation of common fractions is given. Equivalent fractions, the graphing of sets of fractions, comparison of fractions, and the addition, subtraction, multiplication and division of fractions are outlined.

Programs 12 & 13
INTRODUCING DECIMAL FRACTIONS
MORE ABOUT DECIMAL FRACTIONS
Decimal numbers are presented in expanded form and graphed for the better understanding of these

numbers. The addition, subtraction, multiplication and division of decimal numbers are illustrated. The program also includes an introduction to the conversion from one type of fraction to another.

Program 14

RATES AND RATIOS

This program explains rates and ratios. Problems will be introduced involving the use of these.

Program 15

BY THE HUNDRED

Three basic problems of common fractions, decimal fractions and per cent are illustrated. With an understanding of rates it will be seen that these problems are all solved in essentially the same way.

Program 16

SETS OF POINTS

This program provides an introduction to the many basic ideas of geometry. Point, line segment, ray, and line are developed as sets of points. Parallel lines, triangles and polygons are dealt with in a similar manner.

Program 17

A LOOK AT AREAS AND VOLUMES

Areas of triangles, quadrilaterals and parallelogrames, as well as volumes of solids, are presented and explained in this program.

Program 18

MATHEMATICS WITH A DIFFERENCE

(LINES INTO CURVES)

In this final broadcast of the series pupils are shown how to create beautiful curves from straight lines. Classes should be prepared for this program by having a 12-inch ruler, a needle and thread, a pair of scissors and a square of Bristol board, 11 inches by 14 inches in size. Variations of the curves are illustrated. Furthermore, practical applications such as paths of trajectories, solar cookers, parabolic mirrors, etc., will be shown.

ETV TELECAST SCHEDULE

Grade Seven Mathematics

MONDAY TELECASTS

Eighteen Lessons

Station and Locality	JANUARY Start Date		MAY End Date			Time
CBC NETWORK	10	17	16	23	30	
CBLT Toronto	x		x			10.00 a.m.
CHEX Peterboro	x		x			10.00 a.m.
CKWS Kingston	x		x			10.00 a.m.
CBOT Ottawa	x		x			10.00 a.m.
CFPL London	x		x			10.00 a.m.
CKNX Wingham	x		x			10.00 a.m.
CKLW Windsor	x		x	SCHOOL HOLIDAY		10.00 a.m.
CKVR Barrie	x		x			10.00 a.m.
CFCH North Bay	x		x			10.00 a.m.
CFCL Timmins	x		x			10.00 a.m.
CKSO Sudbury	x		x			10.00 a.m.
CJIC S. Ste. Marie	x		x			10.00 a.m.
CKPR Port Arthur	x		x			10.00 a.m.
CBWAT Kenora	x		x			10.00 a.m.
INDIVIDUAL STATIONS						
CJOH Ottawa		x			x	9.30 a.m.
CJSS Cornwall		x			x	9.30 a.m.
CHCH Hamilton		x			x	9.30 a.m.
CKCO Kitchener		x			x	9.30 a.m.
CFTO Toronto	Series not telecast on CFTO-TV					

NOTE: No telecasts scheduled on Monday April 11 and Monday May 23 due to school holidays.

Suggestions for Viewing Television in the Classroom

THE TELEVISION SET

1 Switch on the television set at least five minutes before the start of the program. Turn the volume control down and cover the picture by adjusting the doors of the set, or cover with drapery or other material. This will ensure a minimum of class interruption during the warm-up procedure.

2 Two minutes prior to telecast, make the necessary adjustments to the brightness and contrast controls to ensure picture clarity. Keep volume turned down.

3 Approximately twenty seconds prior to telecast time remove the screen cover and adjust the volume control. Try to avoid adjustments during the program telecast.

4 Window and other lighting reflections on the screen may occur if the television set is positioned at certain angles to light sources. This condition can be avoided by repositioning the television set or through the use of the cabinet doors. If no doors, cardboard shields may be easily fashioned and fixed to the set.

ENVIRONMENTAL FACTORS

5 It is not necessary to black out the classroom. If lighting can be slightly dimmed by closing window drapery or switching off some lights, acceptable light level should result.

6 Tests should be made prior to the broadcast, to ensure that the maximum benefits of viewing and listening are available to each pupil. The seating arrangements will obviously vary with room shapes, type of furniture and number of pupils, but no pupil should be placed in a position that is greater than a 45° angle from a line drawn straight from the centre of the picture tube. Using a 23 inch screen, the minimum distance between pupil and picture should be approximately five feet, and maximum distance from picture should be approximately twenty feet. The television receiver should be raised to a height so that the centre of the picture tube is approximately 66 inches above floor level.

7 These approximate measurements indicate that a square or wide classroom shape is much better than a long narrow room unless of course, desks can be turned towards a long wall or aligned towards a corner.

CAUTION: The measurements shown above are approximate. They may not apply to all classrooms and are offered as a guide only. Long extension cords, antenna leads, and insecure structures for the elevation of the television set should be avoided. Pupils should be discouraged from assisting in setting up the television set or making any adjustments to it.

PROGRAM NO. 1

TEACHERS' GUIDE

What is Mathematics?

This first broadcast of the series aims at introducing the pupil to the world of Mathematics. It will aim to acquaint the viewer with the various aspects of mathematics, to try to develop an appreciation of mathematics as a creative process rather than a formal and static study, and possibly, to rouse hidden interests and abilities.

SUGGESTED ACTIVITIES BEFORE THE ETV BROADCAST

As an introduction to this program, the teacher might discuss with the class such topics as:

(a) What part does mathematics play in our daily lives?
(b) What are the uses of mathematics?
(c) In what occupations and studies is a knowledge of mathematics essential?

SUBJECT CONTENT OF THE BROADCAST

Although mathematics cannot be defined to everyone's satisfaction, several definitions are discussed:

(a) Mathematics as a way of reasoning.
(b) Mathematics as a language — a system of symbols is constantly evolving and is used by mathematicians to communicate their ideas clearly and easily.
(c) Mathematics as truth and beauty — much of the beauty seen in nature may be experienced in mathematical terms, e.g. the Nautilus shell.
(d) Mathematics as a means of solving man's problems such as bridge building, calculating insurance premiums, and calculating batting averages.
(e) Mathematics, therefore, has many aspects, and its uses vary according to specific needs. 'Mathematics is what a Mathematician does'.

A deeper insight into the real meaning of mathematics may be gained by a study of the great mathematicians, their lives and their contributions. Their work brings out the creative aspects of the subject. Such mathematicians were Euclid (Circa 330-275 B.C.), Archimedes (287-212 B.C.), Eratosthenes (275-194 B.C.), Descartes (1596-1650), Sir Isaac Newton (1642-1727), and Karl Friedrich Gauss (1777-1855). A few notes on some of the mathematicians mentioned in the broadcast follow:

ERATOSTHENES (275-194 B.C.)

(i) Although many people think Columbus discovered that the world was round, this is not so. Eratosthenes of Alexandria, some 1,800 years before Columbus, stated that the earth was spherical and even calculated its circumference with surprising accuracy.
(ii) He calculated the distance to the moon and to the sun as well as the distance between the two tropics.
(iii) He involved a means of separating composite numbers from prime numbers.

SIR ISAAC NEWTON (1642-1727)

(i) Sir Isaac Newton has sometimes been referred to as the 'Pioneer of Space' because his discoveries in mathematics and physics are essential to the space programs of today.
(ii) He formulated the law of gravitation.
(iii) He demonstrated that white light is actually composed of a spectrum of colours.
(iv) His work in mathematics and physics is essential today in the launching of satellites.

KARL FRIEDRICH GAUSS (1777-1855)

(i) Gauss was born of poor parents in Brunswick, Germany.
(ii) Even when he was only three years of age,

it is reported that he corrected an error in his father's calculations over certain wage problems.

(iii) His mathematical work has played an important role in electrical engineering.

(iv) He also contributed greatly to the study of astronomy, geophysics, electricity and magnetism.

(v) He calculated the orbit of the planetoid, Ceres, and with an associate, invented the electric telegraph.

(vi) Besides being a great mathematician and often referred to as the 'Prince of Mathematics', Gauss was gifted in the study of languages and was a respected poet.

By a brief study of such notable scholars, it is obvious that mathematicians have contributed to many subject fields.

SUGGESTED FOLLOW-UP ACTIVITIES

(a) Discuss, in class, the various definitions of mathematics given in the broadcast and which definition the pupils consider to be the most important.

(b) Discuss: Which story of the great mathematicians do you consider the most interesting?

(c) One story relating to Gauss' early school days is that he astonished his teacher by calculating in a few moments the sum of the numbers from 1 to 100. He worked out the problem in this manner.

$$\begin{array}{rrrrrrrr}
1+ & 2+ & 3+ & 4+ & 5+ & 6+ & 7+ \ldots\ldots & 100 \\
100+ & 99+ & 98+ & 97+ & 96+ & 95+ & 94+ \ldots\ldots & 1 \\
\hline
101 & 101 & 101 & 101 & 101 & 101 & 101 & 101
\end{array}$$

The sum yields one hundred 101's, that is 100×101 or 10,100. Since each number is added twice, Gauss divided his answer by 2, that is, ½ of 10,100 or 5050. This segment of the broadcast could be illustrated on the blackboard. Will this method work for the sum of the first 20 counting numbers?

(d) The class might try making and cutting a Moebius strip.

TEACHERS' BIBLIOGRAPHY

(a) 'The World of Mathematics' – Hogben
(b) 'The Grant Golden Book of Mathematics'
(c) 'The Wonderful World of Mathematics'

PROGRAM NO. 2

TEACHERS' GUIDE

Numbers and Numerals

The aim of this broadcast is to give the pupils an historical account of our number system.

SUGGESTED INTRODUCTION BEFORE THE ETV BROADCAST

The teacher might discuss with the class such questions as:

(a) How did early man count?

(b) How did they record possessions before numbers were introduced?

(c) What types of numerals, other than the ones we use today, can you write? The teacher might introduce some of these earlier types of symbols as blackboard illustrations.

A brief discussion on one of these questions would lead the pupils into the broadcast lesson.

SUBJECT CONTENT OF THE BROADCAST

The following information will be presented during the program.

1 Primitive man was unable to count and so considered quantities in terms of comparisons of amounts, e.g. groups of arrow heads, bundles of skins, etc. The primitive notions of number ideas will be discussed.

2 The development of tally systems — the use, in early days, of the one-to-one tallying or corresponding placement of pebbles, sticks, etc.

3 The use of fingers as an early method of tallying?

4 The need for symbols in written records. The tracing of symbols in sand or in clay, and markings on rocks for record purposes.

5 A brief discussion on Egyptian, Babylonian, Greek, Hebrew, Roman and Mayan numerals. The disadvantages of these number systems

will be outlined.

6 The development of the Hindu-Arabic numerals is traced from the origin of place value in the sixth century, A.D. to the general acceptance of these number symbols in Europe during the Renaissance.

7 An examination of the Hindu-Arabic system to establish its advantages and its usefulness in computation.

SUGGESTED FOLLOW-UP ACTIVITIES

1 Groups might prepare display charts depicting the various early numeration systems for further discussion and comparisons.

2 An early type of abacus as shown in the broadcast might be prepared from clay or plasticine and using pebbles as counters.

3 Pupils, working in groups or individually, might find further information on the contributions of:
(a) the Venerable Bede, (b) Fibonacci of Pisa, (c) Robert of Chester, and (d) Al-Khowarazmi.

4 Pupils might borrow an abacus and demonstrate its use.

Five ways of writing 22.

EGYPTIAN ∩∩II

BABYLONIAN <<VV

ROMAN XXII

MAYAN  • •

HINDU-ARABIC 22

How would each have written the symbol for 10? How did they write the symbol for 1?

PROGRAM NO. 3

TEACHERS' GUIDE

Understanding Sets

AIM OF LESSON

The aim of this third lesson of the series is to develop an understanding of the notation and use of sets.

INTRODUCTION TO THE BROADCAST PROGRAM

Before the broadcast lesson the following words might be written on the blackboard—sets, finite and infinite sets, subsets, equivalent sets.

Prepare the class as to the aim of the telecast, by posing such a question as: What is a set? This question and others pertaining to sets will be explained in the broadcast lesson.

MAJOR POINTS OF THE BROADCAST

1 An intuitive understanding of a set is developed by means of several collections of objects.

2 Although a set is not formally defined in mathematics, it is illustrated as being a well-defined collection. (Well-defined refers to the description of the members in the set). For example, the set of even whole numbers less than ten is: { 0, 2, 4, 6, 8 }

3 Various ways of naming a set are illustrated by:
   - (a) listing the members in brace brackets,
   - (b) a capital letter—N for the natural numbers,
   - (c) describing in words — the set of all squares of whole numbers { 0, 1, 4, 9, 16, 25 . . . }

4 Set terminology such as the following are explained:
   - (a) *finite set*—one which can be counted. For example, the whole numbers less than a billion.
   - (b) *infinite set*—is one which cannot be counted (there is no largest member).
   - (c) *Subset*—All the elements of a subset are also members of the original set. For example, the set {a, b, c} has eight subsets — {a, b}, {a, c}, {b, c}, {a}, {b}, {c}, {a, b, c}, ϕ.
   - (d) *equivalent* sets have the same number of elements.

     Example

     Three equivalent sets:

SUGGESTED FOLLOW-UP ACTIVITIES

1 Challenge the pupils to list several examples of words used to describe a collection (collective nouns)—team (of football players), herd (of cattle), group (of people), class (of pupils), flock (of sheep), crew (of sailors), pride (of lions), etc.

2 Write a number of descriptions of sets on the blackboard and have the pupils determine whether or not they are well-defined sets.

   Examples
   - (a) *The set of numbers less than 5.* (This is *not* a well-defined set because one does not know what kind of numbers

are involved. For example, do we include fractional numbers, zero, integers, etc?)

(b) *The set of all whole numbers greater than 10*. (This is a well-defined set because it leaves no doubt

$$\{ 11, \quad 12, \quad 13, \quad 14 \ldots \}$$

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PROGRAM NO. 7

TEACHER'S GUIDE

Number Bases

AIM OF BROADCAST

This broadcast aims to establish an understanding of number bases using many different aids and devices.

SUGGESTED ACTIVITIES BEFORE THE BROADCAST

1 The pupils might work in groups and taking 24 objects, place them in groups of 6, 8, 10, 5 and 7. There would be exactly 4 groups of six and 0 left over; there would be exactly 3 groups of eight with 0 left over; there would be 2 groups of ten with 4 left over; 4 groups of five with 4 left over; and 3 groups of seven with 3 left over.

2 The class might be challenged as to how many baseball teams of nine players could be formed in the class. How many substitutes would there be? For example, for 20 boys there would be 2 teams and 2 substitutes. In a class of 23 boys there would be 2 teams and 5 substitutes. For girls, there might be references to Girl Guide groups, basket-ball teams, etc.

3 A base-ten numeral could be written on the blackboard in expanded form using exponents.

EXAMPLE:

$$
\begin{aligned}
&2\ 5\ 9\ 7\\
&= 2000 + 500 + 90 + 7\\
&= 2 \times 1000 + 5 \times 100 + 9 \times 10 + 7 \times 1\\
&= 2 \times 10 \times 10 \times 10 + 5 \times 10 \times 10\\
&\quad + 9 \times 10 + 7 \times 1\\
&= 2 \times 10^3 + 5 \times 10^2 + 9 \times 10^1 + 7 \times 10^0
\end{aligned}
$$

MAIN POINTS OF THE BROADCAST

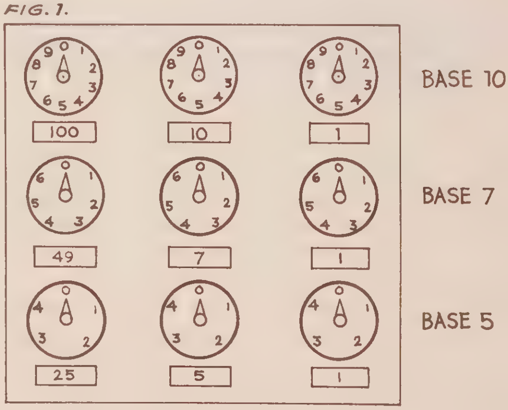
(a) The idea of using different bases for writing numbers is achieved through grouping a class into different teams for a sports day.

For example; groupings might be as follows:

Baseball: 9 pupils. Football: 12 pupils.
Basketball: 5 pupils. Relays: 10 pupils.

(b) The concept of place-value with different bases is further achieved with a meter-like comparison odometer. Such an odometer as used in the broadcast is illustrated below (see figure 1).

FIG. 1.



(c) The meaning of base seven, base five, and other

base numerals is illustrated by emphasising the value of each place, as shown here by columns.

n^3	n^2	n^1	n^0	n represents the base
7^3	7^2	7^1	7^0	n = 7
5^3	5^2	5^1	5^0	n = 5
2^3	2^2	2^1	2^0	n = 2
4^3	4^2	4^1	4^0	n = 4

(d) Numerals are converted to, and from, base ten. For example, to convert 1332_{four} to 126_{ten}, the steps would be as follows:

1 3 3 2_{four}

$2 \times 1 = 2$
$3 \times 4 = 12$
$3 \times 16 = 48$
$1 \times 64 = \underline{64}$
126 in base ten

(e) Addition and subtraction in base five is demonstrated making use of a base five table of addition facts.

+	0	1	2	3	4
0	0	1	2	3	4
1	1	2	3	4	10
2	2	3	4	10	11
3	3	4	10	11	12
4	4	10	11	12	13

(Numerals in Base Five)

(f) To gain a better understanding of how a numeration system works, new symbols and names are invented.

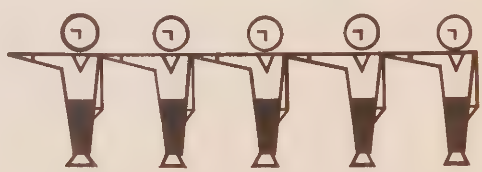
Symbol	Name	Corresponding Value in Base Five
Ø	Null	0 five
/	Stroke	1 five
⌋	Ell	2 five
⊔	You	3 five
◺	Streu	4 five

(g) A table of addition facts is built up with these numerals as illustrated below:

+	Ø	/	⌋	⊔	◺
Ø	Ø	/	⌋	⊔	◺
/	/	⌋	⊔	◺	/Ø
⌋	⌋	⊔	◺	/Ø	//
⊔	⊔	◺	/Ø	//	/⌋
◺	◺	/Ø	//	/⌋	/⊔

(h) A guessing game using cards illustrates how a base with only two symbols can operate. An odometer with only two symbols (0 and 1) is used and discussed in the broadcast. The use of base two in computers is also discussed.

(i) Five boys are used to demonstrate how a "flip flop" circuit works and, at the same time, can automatically count and register in base two.



Teacher counts touching shoulder each time.

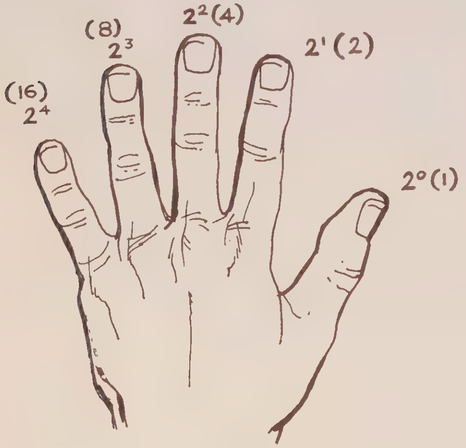
The boys line up with right arms outstretched, each touching the next boy's shoulder. The right arm is either vertical (overhead) or

horizontal. Each time a shoulder is touched, a boy's arm goes up (or down).

SUGGESTED FOLLOW-UP ACTIVITIES

(a) Five class members might demonstrate the "flip-flop" circuit as described in this Guide and as illustrated during the broadcast program.

(b) Finger counting with both hands might be illustrated. This method is shown in the broadcast. Each finger has the value of the power of two. See illustration below.



(c) Other symbols, similar to those made up for the streudel system might be invented by the class.

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PROGRAM NO. 8

TEACHER'S GUIDE

Using Number Expressions

AIM OF THE ETV BROADCAST

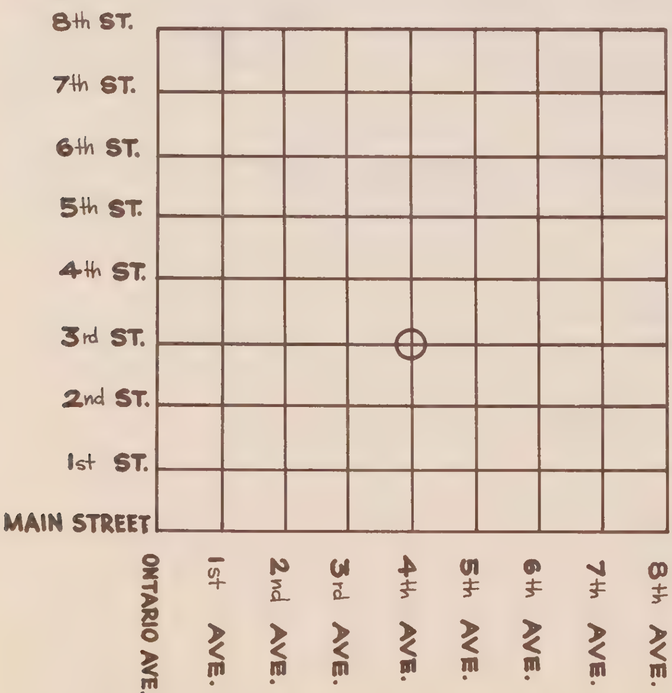
The aim of this program is to gain an understanding of number expressions, placeholders and ordered pairs.

SUGGESTED ACTIVITIES BEFORE THE ETV BROADCAST

1 The pupils might be prepared for the discussion on the topic of relations by making sentences of relations such as "is the son of", "is taller than", "is faster than", "is greater than", etc.

2 The preparation for the part of the program on the graphing of ordered pairs could be achieved by drawing a grid of streets and avenues on the blackboard. The pupils could be challenged to give the location of various intersections selected by the teacher (see figure 1).

FIG. 1.



FOR EXAMPLE, THE INTERSECTION CIRCLE IS AT 4th AVE. & 3rd. ST.

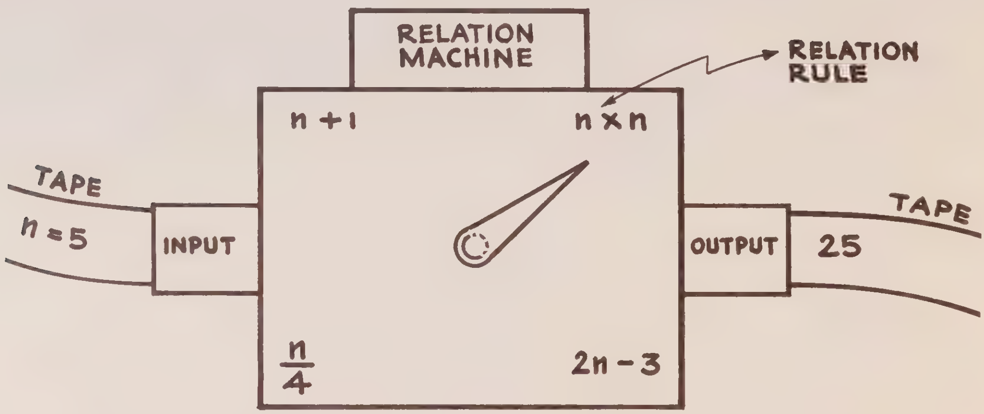
MAIN POINTS OF BROADCAST

1 The *idea of a variable* and *the use of a symbol* for a placeholder is established by the use of a guessing game. The game is as follows:

Think of a whole number $\times$ (any whole number)
Add four to it $\times + 4$
Double this sum $2 \times + 8$
Subtract two from this sum $2 \times + 6$
Take one half of this result $\times + 3$
Now take away the number you first thought of—
Is your answer three?

2 A relations machine is explained to the viewers. It is constructed to give the second member of an ordered pair when the first member is fed into the input and the dial is set to a given relation rule (see figure 2).

FIG. 2



When the dial is set to the relation rule n×n, and one member of the ordered pair is fed into the input (5), the second member (25) is produced.

3 The machine is also used to obtain the relation rule after a chart of ordered pairs has been collected.

4 Using the idea of a policeman giving street directions, similar to the one suggested in the previewing activities, the pupils are shown how to graph ordered pairs.

SUGGESTED FOLLOW-UP ACTIVITIES

1 The pupils might be directed to graph their desk position in the classroom with ordered pairs.

4			JOHN	
3				
2				
1				
	1	2	3	4

Back of classroom.

For example, the position of John's desk could be designated with the ordered pair (3, 4) (3 desks to the right and 4 desks up)

2 Various tables of ordered pairs may be written on the blackboard so that the pupils may determine the relation rule.

n	?
9	3
21	15
45	39
6	0

← What is the relation rule?

3 Tables containing the relation rule and one member of the ordered pair might be written on the blackboard. Pupils would then state the other member of the ordered pair as illustrated below:

	n	2n-3
1		3
2	4	
3		17
4	18	

The answers for this exercise would be:

(1) 3
(2) 5
(3) 10
(4) 33

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PROGRAM NO. 9

TEACHER'S GUIDE

Using Number Sentences

AIM OF BROADCAST

The main aim of this ETV program is to establish the meaning and the use of number sentences in the study of mathematics.

SUGGESTED ACTIVITIES BEFORE THE BROADCAST

1 A few English statements with a subject and a predicate might be written on the blackboard. For example, Lake Huron is one of the Great Lakes. It is one of the Great Lakes.
Class discussion should then establish the fact that the second sentence could be true or false, depending on what word replaces the pronoun, "It".

2 A few number sentences might then be examined. Discussion might establish whether the sentences were true or false.
For example;

	Answer
$8 \times 7 - 2 < 52$	False
$3 \times 13 = 39$	True

3 Filling in the blank spaces with correct answers could introduce the idea of open sentences.
For examplè:
(a)________________ıs the capital of Canada
(b)________________$= 3 \times 9$
(c)________________is the sum of $17 + 18$.

MAIN POINTS OF THE PROGRAM

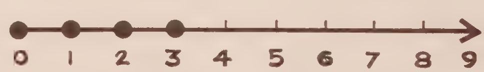
(a) The idea of number sentences is developed by considering such sentences as
Ted is taller than Bob
Three is less than five.

(b) The replacement set is shown to be essential to an open sentence by first replacing the pronoun "He" in the following sentence.
"He was Prime Minister of Canada" with names that would make the sentence "true" or "false". Sir John A. Macdonald makes this sentence "true", but the name, George Washington would make the sentence "false".

(c) In the *open number sentence*
$x + 5 = 16$, $x \epsilon N_o$, the following are shown:
(1) x is the place holder
(2) N_o (or sometimes W is used) which means the set of whole numbers, is the replacement set
(3) the open number sentence includes all of $x + 5 = 16$, $x \epsilon N_o$.

(d) The solution is given to open number sentences such as $2m + 4 = 16$, $m \epsilon N_o$ and to inequalities such as $2x < 12$, $x \epsilon N_o$.

(e) The graphing of solution sets on the number line is presented as follows.



$y < 4$, $y \epsilon N_o \{0, 1, 2, 3\}$

(f) Open number sentences are used to solve problems. Many examples are introduced to show how verbal problems can be translated into mathematical form.

(g) The following aids in problem solving are then discussed:
  1. What is the unknown?
  2. What are the data?
  3. Draw a figure.
  4. Restate the problem.
  5. Can you check the result?
  6. Can you obtain the answer in another way?

(h) Open number sentences with two unknowns are discussed. The solution sets are found to be sets of ordered pairs.

(i) Verbal problems involving ordered pairs are worked out step by step.

SUGGESTED FOLLOW-UP ACTIVITIES

1. The pupils might be given various open number sentences such as $2x + 3 = 39$, $x \epsilon N_o$ and then suggest verbal problems which could be solved by using these sentences. For the given sentence the problem might be; John is 3 years older than his brother, Jim. The sum of the ages equals their uncle's age which is 39 years old.

2. The six aids in problem solving might be written on the blackboard. Various problems might be solved by using these aids.

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PROGRAM NO. 10

TEACHER'S GUIDE

Common Fractions

AIM OF BROADCAST

To investigate the operations and properties of the set of common fractions.

SUGGESTED ACTIVITIES BEFORE THE BROADCAST

1 The class might review the properties of whole numbers which were presented in Program 4, e.g., commutative, associative and distributive laws.

2 The class might suggest different situations which show the need for fractional numbers, e.g., parts of a whole, measurement, comparisons, etc.

SUBJECT CONTENT OF BROADCAST

1 The lesson is introduced by stating that when man began to measure things, he had to invent fractions. Brief mention is made in the program of the use of unit fractions, e.g., ½, ⅓, ¼, by the ancient Egyptians.

2 A model is used to illustrate equivalent fractions. The use of the identity element of multiplication is illustrated to form equivalent fractions, e.g., to change ¾ to twentieths, the numerator and denominator are multiplied by 5. This is like multiplying ¾ by one,

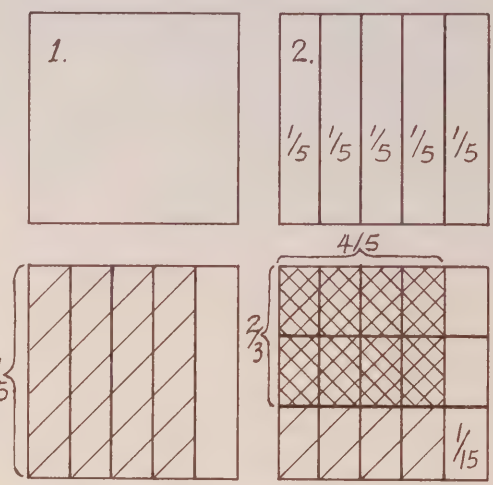
i.e. $\frac{5}{5}=\frac{1}{1}=1 \qquad \frac{3}{4}\times\frac{1}{1}=\frac{3}{4}\times\frac{5}{5}=\frac{15}{20}$

3 The number line is used in the broadcast to illustrate that the commutative law of addition applies to the set of common fractions

e.g. $\frac{3}{4}+\frac{5}{8}=\frac{5}{8}+\frac{3}{4}$

4 Multiplication of fractions is illustrated with the following example.

$$\frac{2}{3}\times\frac{4}{5}=?$$



A square is divided into 5 equal parts. Four of these are taken. ($\frac{4}{5}$ of square is shaded). Then $\frac{2}{3}$ of this is taken. The size of each small part is noted ($\frac{1}{15}$). $\frac{2}{3}\times\frac{4}{5}$ is found to be $\frac{8}{15}$. How can this answer be obtained from $\frac{2}{3}\times\frac{4}{5}$?

$2\times4 = 8 \qquad 3\times5 = 15$

5 After developing the distributive law of multiplication over addition, questions such as $1\frac{1}{2}\times 18$, $2\frac{2}{5}\times 20$ are given as oral questions using this law.

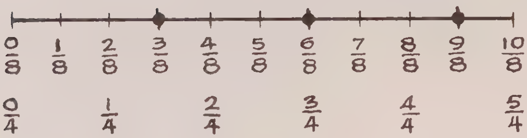
$$\begin{aligned}1\tfrac{1}{2}\times18&=(1+\tfrac{1}{2})18\\&=1\times18+\tfrac{1}{2}\times18\\&=18+9\\&=27\end{aligned}$$

6 Reciprocals are presented and used in division by common fractions.
By using the identity element of multiplication (unity), it is shown that division of a number by a fraction is equivalent to multiplication of the number by the reciprocal of the fraction. Thus division by 5/7 is equivalent to multiplication by 7/5 (7/5 is the reciprocal of 5/7).

$$\frac{10}{21} \div \frac{5}{7} = \frac{10}{21} \times \frac{7}{5} = \frac{2}{3}$$

7 The graphing of sets of fractions on the number line is presented:

e.g. $\left\{\frac{3}{8}, \frac{3}{4}, \frac{9}{8}\right\}$



$\left\{\frac{3}{8}, \frac{3}{4}, \frac{9}{8}\right\}$

8 It is shown that between any two fractions there always is another fraction. This is done by taking the mean (average) of the two fractions, e.g. between 3/50 and 4/50, there is

$$\frac{\frac{3}{50}+\frac{4}{50}}{2} = \frac{\frac{7}{50}}{2} = \frac{7}{100}$$

SUGGESTED FOLLOW-UP ACTIVITIES

1 The class might practice using the distributive law of multiplication, over addition, to multiply fractions mentally.

2 An interesting enrichment exercise is to express common fractions as the sum of unlike unit fractions as the ancient Egyptians did. e.g., Using our symbols

$$\frac{3}{8} = \frac{1}{4} + \frac{1}{8}$$

Many examples can be obtained from multiplying the denominators of

$\frac{1}{3} + \frac{1}{6} = \frac{1}{2}$ by 2, 3, 4, etc.

to obtain $\frac{1}{6} + \frac{1}{12} = \frac{1}{4}$

$\frac{1}{9} + \frac{1}{18} = \frac{1}{6}$ etc.

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PROGRAM NO. 11

TEACHER'S GUIDE

More About Common Fractions

AIM

To use the knowledge of the properties and operations of fractions obtained in Program No. 10 to solve some interesting problems involving common fractions.

SUGGESTED ACTIVITIES BEFORE THE BROADCAST

1 To illustrate that fractions are important in our daily living, the pupils might be challenged to suggest several places where fractions are used. For example, $33\frac{1}{3}$ r.p.m. for records, the tilt of the earth's axis is $23\frac{1}{2}$ degrees, store sales—$\frac{1}{2}$ off stated price, $\frac{1}{3}$ off, etc.

2 A discussion comparing problems solved in class with real-life problems might establish some of the following points:
(a) Problems solved in class often have the exact numbers needed to find the answer.
(b) Real-life problems often contain many other facts—which have to be discarded.
(c) Even after picking out the essential facts,

Eratosthenes knew that when the sun was overhead at Syene (S) (on the tropic of Cancer), it formed an angle of $7\frac{1}{5}$ degrees at Alexandria (A)—a distance of 5000 stadia.

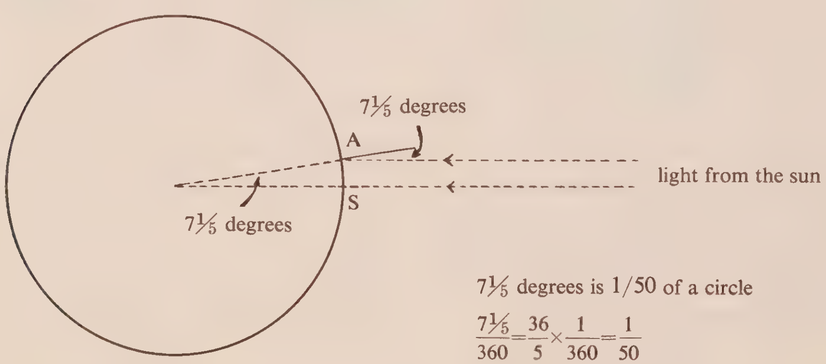

Figure 1

$7\frac{1}{5}$ degrees is 1/50 of a circle

$$\frac{7\frac{1}{5}}{360}=\frac{36}{5}\times\frac{1}{360}=\frac{1}{50}$$

1/50 the circumference of the earth
=5000 stadia
Then the circumference is 50×5000
=250,000 stadia
(approx. 26,000 miles)

there are often many steps involved before the answer can be worked out.

(d) Some real-life problems, because of their practical value are more interesting than many "thought-up" problems solved in class.

SUBJECT CONTENT OF BROADCAST

1 The program is introduced by several oral questions (mental arithmetic). These contain three types of problems involving common fractions.

(a) Finding a fraction of a number.

eg. $\frac{3}{4} \times 38 = x,\ x \in F_0$
($x = 28\frac{1}{2}$)

(b) Expressing one number as a fraction of another. eg. What fraction is 20 minutes of one hour?

$$\left(\frac{20}{60} = \frac{1}{3}\right)$$

(c) Finding a number when a fraction of it is known.

$$\frac{4}{5}x = 30,\ x \in F_0$$
$$(x = 37\tfrac{1}{2})$$

The remainder of the program is devoted to solving problems which involve several steps in their solution.

(a) Actual measurements are made in finding the velocity of a model train.

(b) The meaning of a square rod is illustrated with a diagram 5½ yd. by 5½ yd.

(c) Fractions are used to show how Eratosthenes calculated the circumference of the world. See figure 1.

(d) Fractions are used to develop a formula for converting readings from Fahrenheit to Centigrade scales. See figure 2.

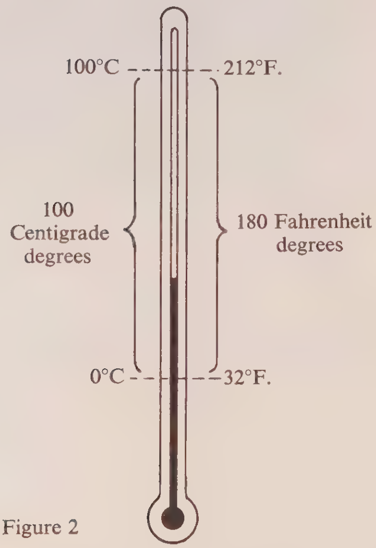

Figure 2

$$180 \text{ Fahrenheit degrees} = 100 \text{ Centigrade degrees.}$$
$$1 \text{ Fahrenheit degree} = \frac{100}{180} \text{ Centigrade degree.}$$
$$= \frac{5}{9} \text{ Centigrade degree.}$$

SUGGESTED FOLLOW-UP ACTIVITY

Practical problems involving fractions might be suggested by the pupils. They might include problems taken from their Science Studies, e.g. problems involving formulae, measurement, etc.

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PROGRAM NO. 12

TEACHER'S GUIDE

Introducing Decimal Fractions

AIMS

The aims of this program are to establish the meaning of decimal fractions and to illustrate how the addition and multiplication of decimal fractions are performed.

SUGGESTED CLASSROOM ACTIVITIES BEFORE THE ETV BROADCAST

(a) The class might discuss the conversion of the monetary system in Australia to a system using the dollar as a unit. This change-over took place on February 14th, 1966. The problems of conversion and the advantages of adopting the decimal system might be discussed.

(b) Similarly the pupils might discuss the advantages of Canadians converting from the foot and pound system of measurement to the metric system.

SUBJECT CONTENT OF BROADCAST

The following are the main points of the program:

(a) The writing of a decimal fraction is illustrated by the following example:

333 means 300+30+3

30 is $\frac{300}{10}$; 3 is $\frac{30}{10}$. How then may $\frac{3}{10}$ be written?

(b) The value of each place, relative to the decimal point is then illustrated.

1000	100	10	1	•	$\frac{1}{10}$	$\frac{1}{100}$	$\frac{1}{1000}$
			5	•	8	3	7

Then, 5.837 is written in expanded form to show its meaning:

$$5.837 = 5 \times 1 + 8 \times \frac{1}{10} + 3 \times \frac{1}{100} + 7 \times \frac{1}{1000}$$

(c) The number 4.653 is converted to a mixed number:

$$4.653 = 4 + \frac{6}{10} + \frac{5}{100} + \frac{3}{1000}$$

$$= 4 + \frac{600}{1000} + \frac{50}{1000} + \frac{3}{1000}$$

$$= 4\frac{653}{1000}$$

It is then established that using decimal fractions is just another way of writing common fractions

$$A = \left\{ \frac{7}{10}, \frac{9}{100}, \frac{17}{1000}, \frac{21}{10000} \right\}$$

$$B = \left\{ .7\ , .09\ , .017\ , .0021 \right\}$$

Sets A and B represent essentially the same thing.

(d) The addition of decimal fractions is illustrated by first converting them to common fractions:

$1.3 + 2.52 + 4.016$

$$= 1\frac{3}{10} + 2\frac{52}{100} + 4\frac{16}{1000}$$

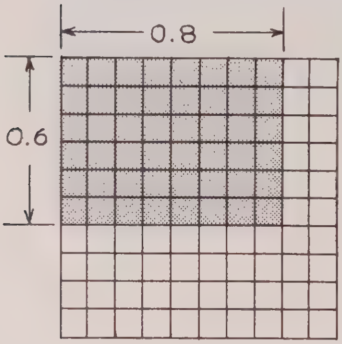
$$= 1\frac{300}{1000} + 2\frac{520}{1000} + 4\frac{16}{1000}$$

$$= 7\frac{836}{1000} = 7.836$$

It is illustrated that these can be added simply by placing the decimal points in a vertical row, writing each digit in this proper column, and adding as whole numbers.

(e) Multiplication of decimals is illustrated in two ways:

(i) A unit region is divided into 100 equal parts Each is $\frac{1}{100}$ of the whole region.



.6 x .8 is seen to be 48 of these units. The product is $\frac{48}{100} = .48$

(ii) The multiplication of decimal fractions is also illustrated by converting them to common fractions

For example,

$$.12 \times .6 = \frac{12}{100} \times \frac{6}{10} = \frac{72}{1000} = .072$$

By examining a table of results, the pupils will discover how to multiply using decimal fractions.

The pupils will then participate by placing the decimal point in products where the multiplication has already been performed.

(f) By examining tables of multiplication by 10, 100, 1000, and .1, .01, and .001, the pupils will discover how to perform these multiplications mentally.

(g) The graphing of sets of decimal fractions is then demonstrated. For example:

$\{.02, .05, .09, .13\}$

(h) The program ends with a brief look at the metric system to show (i) how the metre was originally defined (one ten-millionth the distance from the Equator to either of the Poles) and (ii) to show why conversion from one unit to another in this system is so easy (conversion is simply a shifting of the decimal point).

SUGGESTED FOLLOW-UP ACTIVITIES

1. The pupils might look up the metric units for mass and volume.
2. A chart illustrating different units of measurements might be prepared for the bulletin board.

1 stone	= 14 lb.
1 skein	= 120 yd.
1 puncheon	= 70 gal.
1 furlong	= ⅛th mile, etc.

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PROGRAM NO. 13

TEACHER'S GUIDE

More About Decimal Fractions

AIM OF BROADCAST:

To explain the operation of division with decimal fractions and to examine problems related to this topic under study.

SUGGESTED ACTIVITIES BEFORE THE BROADCAST

1 Program No. 12, last week's broadcast, did not involve the operation of division with decimal fractions. The class could be told that this week's broadcast is, in a way, a continuation of the last program on decimals.

2 The pupils might review the formation of equivalent fractions by multiplying by unity.

For example: $\frac{5}{6}=\frac{5}{6}\times 1=\frac{5}{6}\times\frac{3}{3}=\frac{15}{18}$

Similarly $\frac{6.84}{0.4}\times\frac{10}{10}=\frac{68.4}{4}$

SUBJECT CONTENT OF THE BROADCAST

1 The pupils are introduced to four kinds of division questions involving decimals.

(a) Dividing a decimal by a whole number, for example: $6.48\div 2$

(b) Dividing a whole number by a decimal, for example: $4\div 0.2$

(c) Dividing a whole number by a whole number, where the quotient is a decimal, for example, $4\div 5$

(d) Dividing a decimal by a decimal, for example, 0.35 : 0.7.

2 It is shown that $6.48÷2 is $3.24

$$\frac{\$6+48¢}{2}=\$3+24¢=\$3.24$$

6.48 is then divided by 2 using long division.

3 9.75 : 0.3 is converted to a problem involving division by a whole number.
This is illustrated as follows:

$$\frac{9.75}{0.3}=\frac{9.75}{0.3}\times 1=\frac{9.75}{0.3}\times\frac{10}{10}=\frac{97.5}{3}$$

4 The pupils viewing the program are then invited to participate by writing down what multiple of 10 is needed to simplify division questions involving decimals. The pupils then write down the new division question. For example, $15.201\div 5.63$ should be multiplied by 100 changing it to $1520.1\div 563$.

5 Three types of problems involving decimal fractions are presented.

(a) Finding a decimal fraction of a number.
For example, 0.6 of 24
is simply $0.6\times 24=14.4$

(b) Finding a number when a decimal fraction of it is known.
For example, $0.24x=4.8,\ x \in F_o$
$x=20$

(c) Expressing one number as a decimal fraction of another.
For example, express 36 as a decimal fraction of 50.

$$\frac{36}{50}=x,\ x\in F_o$$

$$\frac{72}{100}=x$$

$$0.72=x$$

6 A table of common fractions and their decimal equivalents is established. For example,

$$\frac{3}{4}=\frac{75}{100}=.75$$

7 Decimal equivalents for common fractions such as $\frac{2}{3}$ and $\frac{5}{11}$ are shown to be recurring decimals.

For example, $\frac{2}{3}=0.666\ldots=0.\overline{6}$ or $0.\dot{6}$

$\frac{5}{11}=0.4545\ldots=0.\overline{45}$ or $0.\dot{4}\dot{5}$

8 Rounding off decimal fractions is then discussed.

For example, 0.2839 is 0.3 correct to the nearest tenth
0.28 correct to the nearest hundredth
0.284 correct to the nearest thousandth.

9 Batting averages are expressed as decimal fractions by dividing the number of hits by the number of official times at bat, and rounding off the answer to three places.

For example, 25 hits out of 83 official times at bat would be $25 \div 83 = .301$ to the nearest thousandth.

10 A problem involving decimals is solved. The diagonal of a square is the length of the side times the square root of two.

With this information the distance from the pitcher's mound to second base is calculated.

SUGGESTED FOLLOW-UP ACTIVITIES

1 The pupils might measure the actual diagonal distances of squares and see how close this measure is to $\sqrt{2}$ times the length of the side of the square ($\sqrt{2}$ is approximately 1.414).

2 Actual batting averages of pupils might be computed in class.

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PROGRAM NO. 14

TEACHER'S GUIDE

Rates and Ratios

AIM

The main aim of this broadcast is to give the pupils an understanding of the meaning and the use of rates and ratios.

SUGGESTED ACTIVITIES BEFORE THE BROADCAST

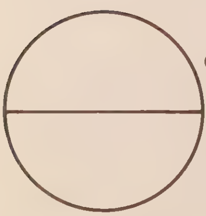
The pupils might be challenged to give examples of commonly used ratios such as:

- gear ratios in racing bicycles;
- ratio of sand, gravel, and cement in the making of concrete;
- ratio of ingredients in cooking recipes, and examples of rates such as:
  - speed of a recording (45 r.p.m.);
  - gas mileage (18 miles per gallon);
  - cost of articles (3 for 98 cents).

MAIN POINTS OF BROADCASTS

1 The idea of ratio is developed by comparing two sets of books — first by subtraction and secondly, by division.

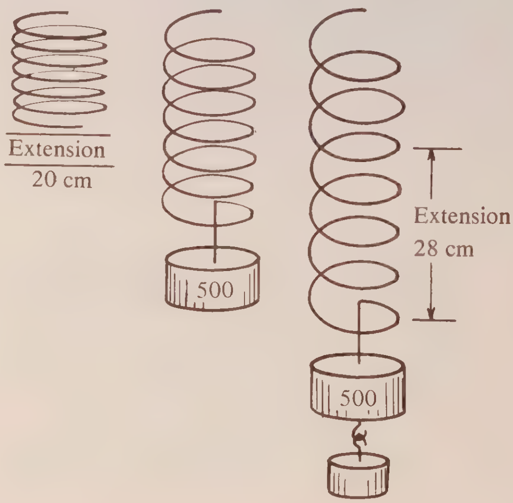
2 An experiment to find the ratio between the circumference and the diameter of a circle is performed. After several circles are considered, it is found that the circumference is always approximately 3 times the diameter.



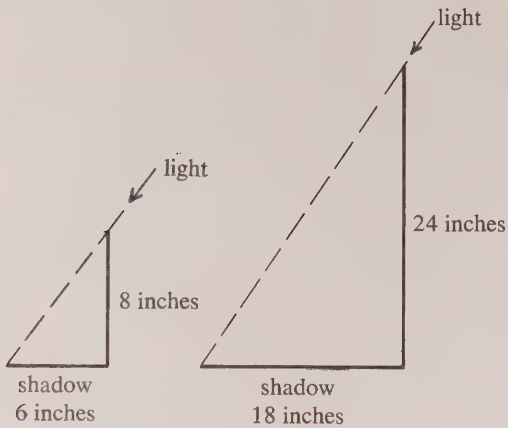
$$\frac{c}{d} \doteqdot 3$$

$$\frac{c}{d} = \pi$$

3 A second experiment comparing the extension of a spring to the weight applied to it is performed. The experiment shows that the extension of the spring is proportional to the weight attached to it.



4 A spot light is shone on certain objects. The height of the objects and the lengths of their shadows are recorded. It is found that the length of the shadows is proportional to the height of the objects.



5 Equivalent ratios such as 3/4 and 6/8 are examined. It is found that with equivalent ratios, cross multiplication yields the same product. For example:

$$\frac{3}{4} \times \frac{6}{8}$$

$$3 \times 8 = 24$$
$$4 \times 6 = 24$$

A knowledge of this is used to solve problems involving equivalent ratios in which one term is unknown. For example: If an 8 foot object casts a shadow of 10 feet, and at the same time another object casts a shadow of 45 feet, how high is the object?

Let the height of the object be represented by x ft. The equivalent ratios are equated.

$$\frac{8}{10} = \frac{x}{45}$$
$$10x = 8 \times 45$$
$$10x = 360$$
$$x = 36$$

Then the height of the object is 36 feet.

6 It is established that when two measures are being compared as ratios, the same unit of measure must be used. For example, the ratio of the height of a 5 foot boy to the height of his 48 inch sister may be expressed as 60 to 48 or 5 to 4, but not as 5 to 48 or 60 to 4.

7 The two-term ratio form may be used to relate different quantities in cases such as these: 3 goals per game, 60 miles per hour, or 33¢ per dozen. When used in this way, these comparisons are known as rates or rate pairs.

8 Problems involving gas mileage and gear ratios are solved during the program.

9 The broadcast concludes on the thought that a most important rate is the rate per hundred or the rate per cent. This is the topic which will be presented in the next program.

SUGGESTED FOLLOW-UP ACTIVITIES

1 The pupils might conduct various experiments involving ratio. For example, the circle experiment and the spring experiment. An excellent activity involving shadows might be conducted in the school yard or sports field. Various objects and the shadows formed with the sun could be measured.

2 Pupils might bring in gears from bicycles, old washing machines, or gears from plastic toys.

3 A chart showing commonly used rates from local businesses and newspapers might be constructed. For example, prices of groceries, gasoline, electricity, dry goods, etc. (Refer to suggested activities section for further ideas.)

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PROGRAM NO. 15

TEACHER'S GUIDE

By the Hundred

AIMS OF THE BROADCAST

1 To explain the meaning of per cent.

2 To illustrate how the three basic problems with per cent can be solved using the ratio method.

SUGGESTED INTRODUCTION TO BROADCAST

The class might be challenged to give examples of the uses of per cent as used in daily life. These examples might be listed on the blackboard. For example, Sales Tax 5%, Rate of Discount, Interest on Bank Deposits, Discount on Loans, etc.

SUBJECT CONTENT OF THE BROADCAST

1 The program is introduced with the statement that a knowledge of per cent is like putting money into your pocket.

2 Several examples of the use of per cent are given. The reason for its wide use is that per cent is one of the best ways of making comparisons.

3 During the program presentation a board with ten rows of ten circles is used to show the meaning of per cent. From this illustration a table is built up to show the common fraction and decimal fraction equivalents to various per cents. For example, when 20 of the hundred circles are considered; the reading is as follows:

Common Fraction		Decimal Fraction	%
In Hundredths	In lowest terms		
$\frac{20}{100}$	$\frac{1}{5}$	.2	20

4 It is then established that three basic types of problems involving per cent can be solved in essentially the same way by considering per cent as a two term ratio with the second term 100.

Hence, 35% means 35 per 100 or $\frac{35}{100}$

(a) To find 16% of 75 means to find a number x such that the ratio of

$\frac{x}{75}$ is equivalent to the ratio $\frac{16}{100}$

Then, $\frac{16}{100}=\frac{x}{75}$

Using the test for equivalent ratios:

$100x=16\times 75$

$x=\frac{16\times 75}{100}$

$x=12$

Then, 16% of 75 is 12.

(b) What % is 12 of 30?

Let 12 be x% of 30

x% means $\frac{x}{100}$

The equivalent ratio is $\frac{12}{30}$

Then, $\frac{x}{100}=\frac{12}{30}$

$30x=1200$

$x=40$

Then, 12 is 40% of 30

(c) If 80% of a number is 36, what is the number? Let the number be represented by x.

80% as a ratio is $\frac{80}{100}$

The equivalent ratio is $\frac{36}{x}$

$$\frac{80}{100}=\frac{36}{x}$$

$$80x=3600$$

$$x=45$$

Then 80% of 45 is 36

5 The pupils are invited to participate by writing down the open number sentences for similar problems.

6 Solutions to practical problems such as discount buying and interest rates on loans are illustrated. A second method is used in calculating the interest on money as it involves the formula: $i=p\,r\,t$

In a problem, Mr. Brown borrows $1600 from the bank to buy seed in May and repays it after the harvest (5 months later). The bank interest rate for borrowing is 6 per cent per annum. Later, the following is shown:

The amount of the loan ($1600) is the principal (p).

The 6% per annum which the bank charges is the rate of interest (r), and the 5 months is the time (t).

$p=\$1600$

$r=6\%$ per annum $\left(.06 \text{ or } \frac{6}{100}\right)$

The fractional form must be used in the formula.

$t=5$ months $\left(\frac{5}{12}\text{ yr.}\right)$

The time must be in the same unit as given in the rate of interest

$$i=p\,r\,t$$

$$i=1600\times\frac{6}{100}\times\frac{5}{12}$$

$$i=40$$

Then the interest is $40

SUGGESTED FOLLOW-UP ACTIVITIES

1 Since pupils usually have trouble during the first stages in expressing the proper ratios, more practice such as the oral exercise given in the broadcast might be helpful.

2 After the ratio-method is understood, other methods might be tried. For example, in finding the per cent of a number, the one per cent method makes many questions just an oral exercise.

EXAMPLE:

Find the sales tax (5%) on pair of skis costing $16.00

Since 1% of $16 is $\frac{1}{100}$ of \$16=\$.16 or 16¢

5% of $16 is 5×16¢=80¢

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PROGRAM NO. 16

TEACHER'S GUIDE

Sets of Points

AIM OF BROADCAST

The aim of this broadcast is to introduce some basic concepts of geometry.

SUGGESTED ACTIVITIES BEFORE THE BROADCAST

1 The pupils might be challenged to define geometry.

2 Various geometric forms from nature and various geometric figures used by man could be listed on the blackboard.
For example, from nature — mineral crystals, pine cones, snowflakes, compound eyes of insects, etc., and in the second category — bridges, highways, architectural features for Expo 67, etc.

MAIN POINTS OF THE BROADCAST

1 The program is introduced with a puzzle which is impossible to solve if the answer has to be worked out on a plane. The solution is possible on a Moebius strip. This, however, is not part of our everyday experience.

2 Several optical illusions are shown to indicate that our eyes sometimes "play tricks on us".

3 Frequently experienced examples such as the apparent joining of railway tracks in the distance, the apparent decrease in size of telephone poles, etc. are mentioned.

4 These illustrations are given so that pupils are made aware of the fact that one must be careful not to jump to conclusions too rapidly.

5 One of the best ways of appreciating geometry is to observe common things in nature. Several examples of beautiful designs from nature which are geometric patterns are illustrated:

(a) snowflake — hexagonal shape

(b) butterfly — to show bilateral symmetry

(c) starfish — to show radial symmetry

(d) beehive and the compound eye of an insect — hexagons give a maximum area for a given amount of material with no waste space

(e) Mammal eye — for simple eyes, the best shape is the circle, as it gives the maximum area (letting in most light)

(f) nautilus shell is shown as an example of a spiral

(g) volcano — example of a cone in nature

(h) spider's web — looks like concentric circles but formed with lined segments.

6 A few examples of how primitive man imitated some shapes he observed from nature are illustrated.

7 It is stated that geometry involves the study of space — space being everywhere and filled with an infinite number of points.

8 A point in geometry is an undefined term. It is shown that to define a point, other words are needed, which, in turn, would have to be defined. A point, however, may be thought of as a fixed or immovable position in space.

9 Models of points, lines (straight, curved, broken, parallel, concurrent, rays, line segments) and angles are illustrated.

10 It is shown that a figure which consists of two rays with a common end point is an angle.

11 Three angles (right, acute and obtuse) are shown in an artist's drawing.

12 A peg-board is used to show a simple curve, simple closed curves, and several polygons (triangle, quadrilateral, pentagon, and hexagon).

13 The rigidity of triangles is demonstrated by using pieces of wood. Examples of towers and bridges using these triangles for rigidity are shown.

14 The following types of triangles are introduced:
scalene triangle — all sides are different lengths
isosceles triangle — two sides are equal
equilateral triangle — three sides are equal

15 It is demonstrated that when the mid points

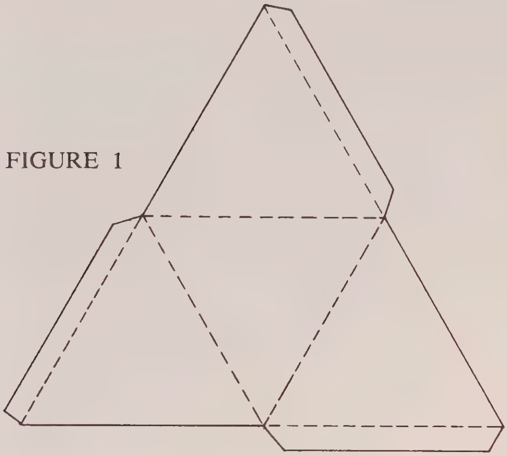

FIGURE 1

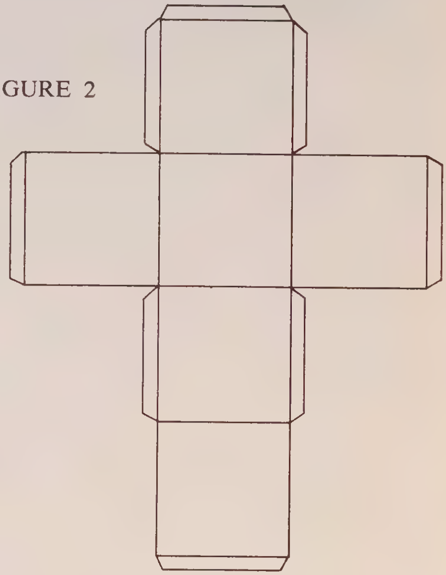

FIGURE 2

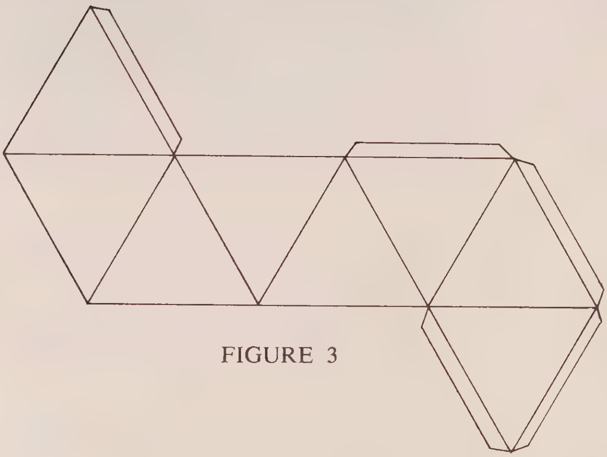

FIGURE 3

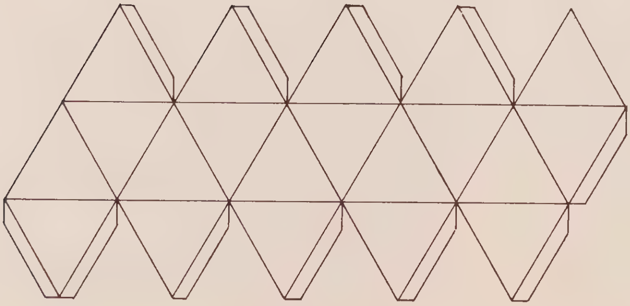

FIGURE 4

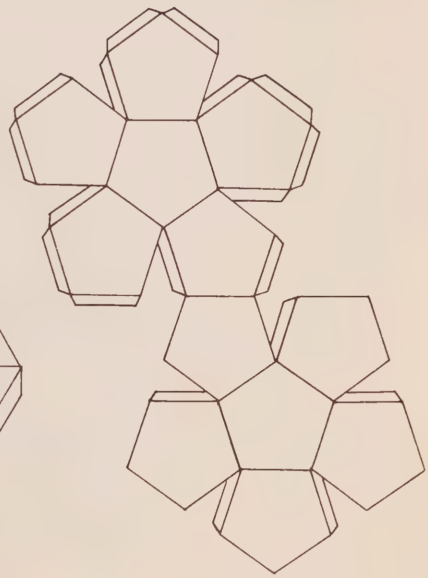

FIGURE 5

of an equilateral triangle are joined, four equilateral triangles are formed (see figure 1). When such a drawing is cut out and folded along the dotted lines, a solid figure with 4 faces is formed. The net diagrams of other solids such as illustrated in figures 2 to 5 (inclusive) are shown and folded.

NOTE:

These figures can be readily constructed by using Bristol board. To give good folding, hinged joints can be formed by cutting *half way* through the thickness of the Bristol board with a razor blade.

16 Another way to learn about geometry is by "doodling" with a pair of compasses. Beautiful designs created with the use of a pair of compasses are illustrated.

17 One of the most fascinating puzzles involving geometric figures, the tanagram, is shown (see figure 6). All seven pieces must be used in each arrangement. For examples, see figures 7, 8, 9 and 10.

18 The program ends by illustrating some practical applications of geometry (e.g. machines, buildings, etc.) and show it to be a very useful study to man. This usefulness, along with its beauty, makes geometry a subject well worth further study.

SUGGESTED FOLLOW-UP ACTIVITIES

1 Further examples of geometry in nature might be listed on the blackboard or pictures of geometrical examples in nature might be placed on the class bulletin board.

2 Pupils might make geometric designs with the use of pairs of compasses.

3 Pupils might construct a tanagram puzzle using Bristol board, or masonite.

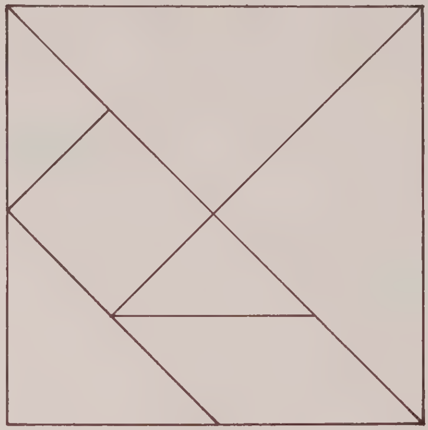

FIGURE 6

FIGURE 7

FIGURE 8

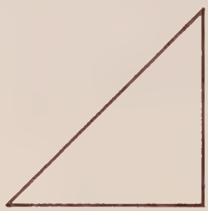

FIGURE 9

(REDUCED SCALE)

FIGURE 10

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PROGRAM NO. 17

TEACHER'S GUIDE

A Look At Areas and Volumes

AIMS OF BROADCAST

To demonstrate how to find:

(a) areas of various figures,

(b) volumes of various solids, and

(c) how the formulae are developed.

SUGGESTED ACTIVITIES BEFORE THE BROADCAST

1 Pupils might be questioned as to the various quantities which can be measured, for example, length, time, weight, area, volume, heat, sound, money, electricity, etc. The various *units of measure* might then be written on the blackboard beside these quantities.

2 Immediately before the broadcast, the pupils might be given the following problem which is used to introduce the program.

Problem: How is it possible to measure exactly 2 pints using only an 8 pint and a 5 pint container? The containers are not marked in any way. The answer is provided in the telecast.

SUBJECT CONTENT OF THE BROADCAST

1 It is illustrated that a measurement associates a number with some unit of measure in order to describe some property of an object or thing. Some example of units are given.

2 After developing the formula for the area of a rectangle, $A = lw$ or $A = bh$, it is shown that the area of a parallelogram can also be found by using the formula, $A = bh$. See figure 1.

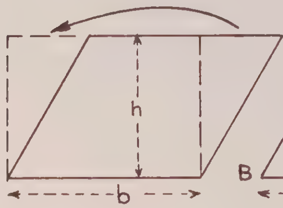

FIG. 1

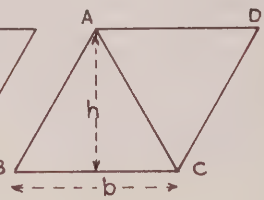

FIG. 2

3 Since the area of a triangle ABC is one half the area of the parallelogram ABCD, its area can be found by using the formula $A = \frac{1}{2}bh$. See figure 2.

4 By using blocks, it is shown that the volume of a rectangular prism can be found by using the formula $V = lwh$.

Since length times the width (lw) equals the area, the formula for the volume may be expressed as

$$V = Ah.$$

It is further illustrated that this formula may be used to find the volume of any rectangular prism, e.g. a triangular prism.

5 An experiment is performed to show that the volume of a pyramid can be found by using the formula $V = \frac{1}{3}Ah$

V = volume, A = area of base,

h = height of pyramid.

SUGGESTED FOLLOW-UP ACTIVITIES

The class might carefully examine the problem. What is the largest rectangle which can be enclosed by a yard of cord?

(a) Various measurements could be recorded:

Length	Width	Area
18	0	0
17	1	17
16	2	32
15	3	45
14	4	56

(b) These results might be graphed. Plot the area against the length (see figure 3).

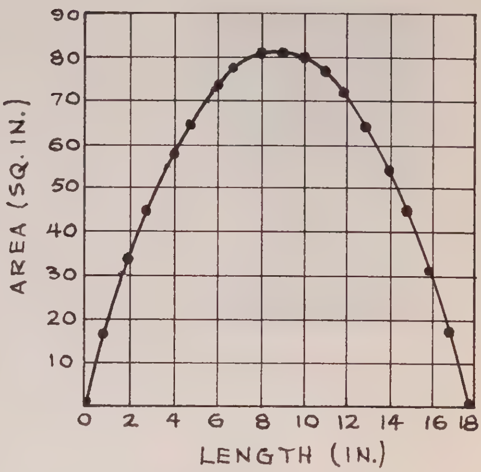

FIGURE 3

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PROGRAM NO. 18

TEACHER'S GUIDE

Mathematics With a Difference (Lines into Curves)

AIM OF THE BROADCAST

This is an enrichment, activity program. Pupils will discover how to create beautiful designs.

CLASS PREPARATION FOR THE BROADCAST

Each pupil should have the following equipment:

- a 12-inch ruler
- a well-sharpened pencil
- a sheet of paper
- a large needle (approx. 2 to 2½ in. long)
- several feet of thread (button thread or elasticized thread are best suited for this project).
- 2 pieces of Bristol board, each piece approximately 11 x 14 inches, i.e. a quarter sheet.

To derive the greatest benefit from this program, each pupil should make the following preparations:

(a) An angle with equal arms (about 7 inches) should be drawn. Each arm should be marked off into half-inch units. See Figure 1.

(b) A larger angle similar to the one shown in Fig. 1 should be drawn on a piece of Bristol board. Using a needle, punch holes along the arms at each half-inch interval.

MAIN ACTIVITIES IN THE PROGRAM

1 Pupils are shown how to make a beautiful design by joining points on the angle with straight lines. (1 to 1, 2 to 2, 3 to 3, etc.). The result is a curve, or more accurately, a parabola.

2 Every other space is coloured to achieve an interesting pattern (tessellation) — Compare this with optical art.

3 The same effect may be achieved by stitching with coloured thread on cardboard.

4 Several examples of curve stitching are then shown. For example, in crosses, rectangles, hexagons. Interesting effects are achieved by using overlays of different coloured thread.

5 In three dimensions, the curve becomes a paraboloid. Its use in headlights of cars, solar cookers, solar furnaces, and radio telescopes is illustrated. It is shown that parallel rays of light are reflected by a parabolic mirror through a focal point.

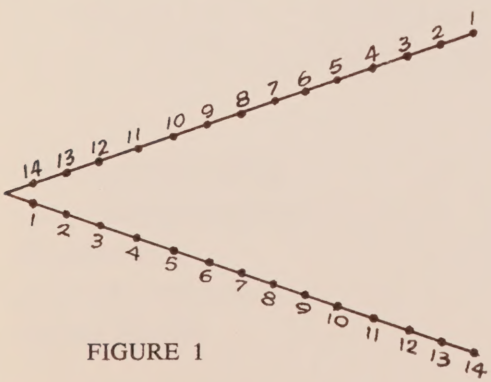

FIGURE 1

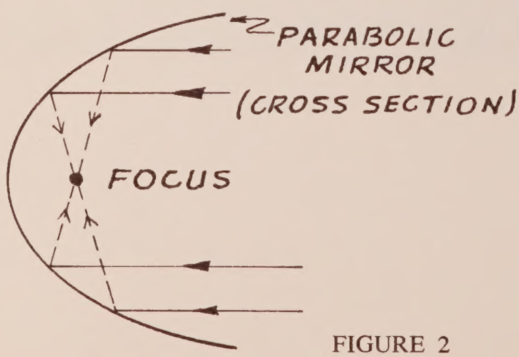

FIGURE 2

Also, if a light is placed at the focus of a parabolic mirror, light is reflected in parallel rays.

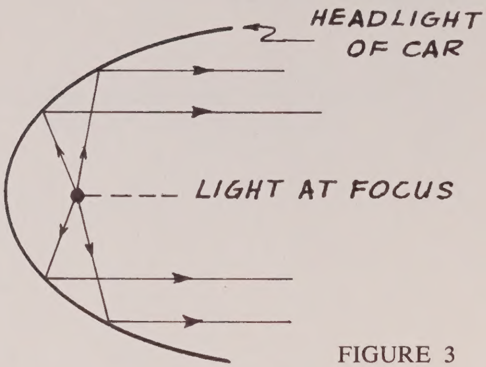

FIGURE 3

6 Curve stitching in three dimensions is also illustrated by using a space corner of three pieces of peg board.

SUGGESTED FOLLOW-UP ACTIVITIES

1 Pupils should be encouraged to create many different designs with thread.

2 Some pupils might wish to build space corners out of masonite. Holes may be drilled or punched. Quarter-round moulding may be used to reinforce the joints. Spray with paint and stitch.

3 Headlights of cars, parabolic shaving mirrors, solar cookers, fish weight parabola (see notes on program 6) along with pictures of parabolic radio telescope antennae and suspension bridges might be displayed in the mathematics corner of the classroom.

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